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Public Service Broadcasting of Sport, Shows, and News as Economic Solution to the Voter's Paradox of Rational Ignorance

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October 18, 2010

Abstract

Rational individuals may use a Public Service TV channel as a welfare improving institution to solve the paradox of being uninformed. To induce voters to watch unbiased serious informational content the Public Service TV channel is not only broadcasting (unbiased serious) news but also sport and shows even though in many markets sport and shows are broadcasted by private TV channels. Our approach is based on two-sided markets and the assumption of decreasing marginal returns of the factor information in the production process of democratic decisions.

JEL: L82; D72; L32

Keywords: Media Industry, voter behavior, two-sided markets, education

1 Introduction

A central paradox in the rational choice approach of politics is that voters know that democracy works better if people are well informed but no rational voter is willing to collect such kind of information in a costly manner. As Downs (1957, p. 246) writes: "(1) rational citizens want democracy to work well so as to gain its benefits, and it works best when the citizenry is well-informed; and (2) it is individually irrational to be well-informed." Since then both propositions, known as the paradox of rational ignorance, were challenged by many authors but have not been disproved until now. Wittman (1989) argues that informational problems in democratic markets are being exaggerated and democracy works even if voters are not well informed. If voters do not systematically err and if there are at least some people who know the right answer, then the incorrect votes cancel out and an optimal solution is found. The so-called "wisdom of the crowds" (Surowiecki, 2004) is impressive even if each crowd member's knowledge is completely unimpressive. However, if voters' errors are systematic, the informational gap of the voters aggregates to wrong decisions. Concerning rational ignorance, the question is not whether the crowd in "Who Wants to Be a Millionaire?" unsystematically errs in answering the question "Which group score number one in the UK single charts on April 4th, 2010?", but whether voters systematically err in questions of direct political relevance like "How high should a minimum wage be?". Caplan (2002) shows that for economic questions, arguably the foremost important political questions, the opinion of voters systematically differ from the opinion of economists. The average voter, for example, does not see the link between excessive high wages and unemployment.

Some people get economic information as a by-product of their professional (and paid) work; other people gather this kind of information just for fun. However, if you are not a professional economist or an economics fan, gathering information is costly and earnings are questionable. Costs are predominantly opportunity costs of time to consume such kind of information. Earnings are negligible when the information is used only to improve a voting decision where the probability that the vote is decisive is insignificant. Because of the irrelevance of a single vote, even utility decreasing decisions bear no private costs. For example, a high-income earner can easily vote for high income taxes because she knows that her vote does not change the outcome of the vote.

Controlling for all other variables, two activities prevent systematic errors of voters: education and economic training. More educated voters and more economically trained voters share opinions that are closer to the expert's opinion (Caplan, 2002). The opportunity costs of popular misconceptions about economics are large because they concern all fields of economic policy. Because the crowd systematically is at fault regarding economics, better informed and educated people improve the outcome of the democratic process and therefore reach better economic policies.

In addition to the paradox of rational ignorance there is the paradox of voting (Downs, 1957): Because the chance of exercising the pivotal vote is tiny, the costs of voting will normally exceed the expected benefits and therefore a utility maximizer does not vote. If nobody votes, democracy does not work. There is much empirical evidence that voter turnout rises with information and education (Wolfinger and Rosenstone, 1980; Matsusaka and Palda, 1999) and empirical estimates by Lassen (2005) confirm a sizable and statistically significant causal effect of being informed on the propensity to vote. Gentzkow (2006) shows that substitution of media with different grades of political coverages provides a plausible mechanism linking media supply and voting. He shows that television caused fewer voters to go to the polls. This effect was particularly strong in those elections where the drop in information caused by little coverage of the poll's topics by television was shown to be the largest. Furthermore, utility-maximizing consumers receive higher payoffs from voting and therefore vote with higher probability when they are more confident of their vote choice (Matsusaka, 1995). To summarize, democracy works better if more people are informed. For the paradox of rational ignorance this is because better informed voters make better decisions; for the paradox of voting this is because better informed citizens are more likely to vote.

If the production of the public good democracy is efficient, public production financed by taxes may be the solution to the free rider problem. However, the costs of production of any physical information (pdf, TV, film) are not the only costs that accrue in the process of supplying democracy. An individual has to pay another type of costs: he has to spend time to consume the information. Therefore, even if information is provided for free (free-to-air Public or Private TV, free downloads from the Internet), it is still rational not to use them because the consumption generates opportunity costs of time a rational voter is not willing to bear.

Sometimes the problem that a welfare-enhancing institution depends on the time input of the citizen is solved by law. Compulsory school attendance is usual in many countries and produces a minimum quality standard of informed citizens. However, information is getting out of date and after some years the stock of information learned in school is not a proper base to participate in regular elections. Updates are necessary, but some voters are not willing to voluntarily pay the price of time. Compulsory school attendance for voters, for example eight hours before each election, however, is not feasible: it is expensive, ineffective, not constitutional, and not focused.

A traditional strategy adopted by broadcasters to attract viewers for less popular content is to broadcast this content as a follow-up of very popular content (Armstrong and Weeds, 2007). The strategy to schedule an unpopular program between two popular ones is called "Hammocking" and could be used to encourage consumers to watch more informational programs. However, this strategy loses effect where many different channels are broadcasted since consumers may switch to a more entertaining channel.

Another strategy is to place informational messages, for example about the risk of investing all savings in only one asset, within popular game shows. However, game shows including informational content may be less entertaining than competing game shows. The "product placement" strategy of including informational messages into shows also suffers from the competition of channels.

But in spite of the competition of channels, the advertising industry is still able to get attention and time from consumers. They are using two-sided markets (Rochet and Tirole, 2003; Armstrong, 2006) by subsidizing consumer products as films and TV shows in exchange for the time consumers spend watching their commercials. We show that this approach can be used as a blue print to solve the voter's paradox of being uninformed. Consumers are willing to spend time for watching serious news if it is in between a broadcast of the cup final. Therefore, as private TV channels send films, shows and sport to get its commercials seen, a Public Service TV channel may send "Back to the future", "NCIS", and the cup final to get their news and public information programs seen.

We show that rational individuals of a society may use Public Service Broadcasting as a welfare improving institution to solve the paradox of rationally being uninformed. Therefore, our result adds to the discussion whether Public Service Broadcasting is a worthwhile institution (Armstrong, 2005). In the literature there are three traditional rationales for Public Service Broadcasting (Brown, 1996). The first is that the welfare of viewers is enhanced by programs that would not be supplied in response to market demand, for example a Shakespeare play or a Wagner opera. This argument is paternalistic and does not convince if consumers are sovereign. The second argument is an infant industry argument: consumers need a supply of quality programs to build their preferences about quality. This may hold for high-quality serious news, but not for broadcasting sport and shows. Last but not least there could be a market failure in the broadcasting market. The current approaches searching for failures in the market for broadcasting usually look at consumers with heterogenous preferences for different type of programs, the platform (channel) firms, and the advertising industry (Anderson and Coate, 2005; Armstrong, 2005). Anderson and Coate (2005) show that equilibrium advertising levels can be above or below socially optimal levels because producers do not fully internalize the nuisance costs of advertisements. Furthermore, markets can provide too few or too many programs. These arguments would justify the regulation of the broadcasting market, for example through commercial ceilings or the introduction of a Public Service TV channel broadcasting only a type of program that is not provided by the market.

Another argument in favor of Public Service TV is that because people hold beliefs which they like to see confirmed and media outlets can slant stories toward these beliefs, news are biased and Public Service TV should correct this bias by offering unbiased information. Mullainathan and Shleifer (2005) show that on topics where peoples' beliefs diverge such as politically decisive issues, media outlets segment the market and slant toward extreme positions. However, because access to all news sources provides an unbiased perspective in the aggregate, they do not see a failure of the market for news and therefore no need for news supplied by a public firm.

In addition, many authors (Downs, 1957; Coase, 1974; Posner, 1986; von Hagen and Seabright, 2007, p. 6) argue that consumers value politically relevant information less than a social planner would do and that a first best outcome requires encouraging consumption of news. But in competitive markets, firms have to offer what consumers want, i.e. no or soft news. Hamilton (2004) provides evidence that the quantity of policy news on U.S. network television news has fallen, arguably because regulatory controls were loosened and competition from cable intensified. The policymaker who prefers completely private broadcasting could think about lessening competition in the media market. However, Gentzkow and Shapiro (2008) balance this argument against the traditional case for competitive news markets like increasing diversity of owner incentives and preserving press independence and summarize that limiting competition is not a persuasive solution to the problem of rational ignorance. Gentzkow and Shapiro (2008) point out that not only the supply of hard news could be increased but also that the supply of more entertaining news should be limited.

All mentioned arguments indicate that welfare could be enhanced through the broadcasting of unbiased serious news or a type of program that is not provided by private TV channels. While focusing on the fact that voters free-ride on information, and therefore consume less information than socially desirable, and emphasizing the opportunity costs of time voters incur by processing information, we show that a Public Service TV channel, that is broadcasting news and information only, may not be the optimal solution for the problem of rational ignorance. We show that the optimal institution to induce voters to watch unbiased serious informational content may be a Public Service TV channel which is not only broadcasting unbiased serious news but also sport and shows.

2 The model

The number of voters is normalized to one; we denote an individual voter as $i \in [0, 1]$ and the amount of information voter i possesses as I_i.

We call the output of a democratic process Y, with $Y \geq 0$ and a larger Y implying a better decision and assume that information I is the only factor of production. Because of universal suffrage each voter equally influences the production of Y through his amount of information, i.e. two voters $i, j \in [0, 1]$ who share the same amount of information $I_i = I_j$ have the same marginal product $\partial Y/\partial I_i = \partial Y/\partial I_j$. Therefore, there exists a function $g : [0, 1] \to \mathbb{R}$ such that $Y = \int_0^1 g_i(I_i)di$. We assume that marginal information has a non-negative effect on the decision, either because information improves participation or because information results in a more adequate vote. Furthermore, we assume a diminishing marginal product of information. A minute of additional information is much more useful for a voter who is quite uninformed than for a voter who has already a large stock of information. Therefore, we define the output of the democratic process as

$$Y = \int_0^1 I_i^\alpha di$$

where $0 < \alpha < 1$ determines how fast the marginal productivity of information diminishes. If we assumed a constant marginal product of information ($\alpha = 1$), our model would reproduce the standard welfare economics policy implication that a Public Service TV channel only has to broadcast programs for minorities, education for children, serious news, and dramas which no private channel wants to show (Armstrong, 2005; Solberg, 2007).

The media part of our model follows Anderson and Coate (2005). There are three types of TV programs. First, a TV channel may broadcast entertaining shows, where the broadcasting time of shows is denoted by $t_s \in [0, 1]$. Second, a TV channel may broadcast informatory programs like newscasts, features about science, or economics etc. where the broadcasting time of information program is denoted by $t_{inf} \in [0, 1]$. And finally, a TV channel may broadcast commercials, where broadcasting time of television advertising is denoted by $t_a \in [0, 1]$.

Each voter i watches television for one unit of time. Voters are heterogeneous in their preferences for shows and information. No voter likes television advertising. Therefore the utility from commercials is assumed to be zero and the utility of voter i from TV consumption is

$$U_i = it_s + 1/2t_{inf}.$$

The show-type consumers $i > 1/2$ prefer shows over information and the information-type consumers $i < 1/2$ prefer information. Depending on i the utility differences between an additional show or an additional informational broadcast is $i - 1/2$.

We assume that consumers do not switch channels but watch the utility maximizing TV channel. For simplicity we assume that there are only two TV channels, a show channel and an information channel. The show channel does not broadcast any informational program and the information channel does not broadcast any show program. This is consistent with a TV market that, because of high fixed costs, only bears two channels. In this case it is a Nash-Equilibrium strategy, i.e. no other type of program can increase the market share to focus on one type of consumers. Because of our assumption that both groups of consumers are equal, the market share is one half.

We normalize the pre-TV information of each voter to zero, such that a positive I is only reached by watching informational programs on TV. Therefore, a voter who watches channel ch possesses $I_i = t_{inf}^{ch}$ information.

For TV channels we assume that the time of broadcasting commercials $t_a > 0$ is exogenously given. In many countries advertising ceilings are imposed (Motta and

Polo, 1997; Anderson, 2007), and in Europe the directive 2007/65/EC concerning the pursuit of television broadcasting activities rules in Article 18 (1): "The proportion of television advertising spots and teleshopping spots within a given clock hour shall not exceed 20 %." We assume that legal ceilings are fully utilized.

Without Public Service TV all consumers of type $1/2 \leq i \leq 1$ watch shows only and have information of $I_i = 0$ whereas information-type consumers $0 \leq i < 1/2$ receive information of an amount of $I_i = (1 - t_a)$. Therefore, the output of the democratic process yields $Y = (1 - t_a)^\alpha/2$.

We now consider the introduction of a Public Service TV channel that is broadcasting no commercials but information and shows. Assuming an information broadcasting time denoted by $t_p \in [0, 1]$, the remaining broadcasting time of the Public Service TV channel is used for shows so that the broadcasting time for shows yields $1 - t_p$.

Former information channel viewers, that is information-type consumers $0 \leq i < 1/2$, switch to the Public Service TV channel if

$$i(1 - t_p) + 1/2t_p \geq 1/2(1 - t_a).$$

Therefore, all i with

$$1/2 > i \geq \frac{1 - t_a - t_p}{2(1 - t_p)} \overset{def}{=} i_s^1 \tag{1}$$

are the new information-type Public Service TV channel viewers.

Thus, for $1 - t_p \leq t_a$, all information-type consumers switch over and $I_i = t_p$ for all $0 \leq i < 1/2$. If $1 - t_p > t_a$, then

$$1/2 - \frac{1 - t_a - t_p}{2(1 - t_p)} = \frac{t_a}{2(1 - t_p)} \tag{2}$$

information-type consumers switch. Then $I_i = t_p$ for $i_s^1 \leq i < 1/2$ and $I_i = 1 - t_a$ for $0 \leq i < i_s^1$.

Former show channel consumers, that is show-type consumers $1/2 \leq i \leq 1$, switch to the Public Service TV channel if

$$i(1 - t_p) + 1/2t_p \geq i(1 - t_a).$$

This holds for $t_a \geq t_p/2$, meaning all show-type consumers $1/2 \leq i \leq 1$ switch. Then $I_i = t_p$ for all $1/2 \leq i \leq 1$.

If $t_a < t_p/2$, all

$$i \leq \frac{-t_p}{2(t_a - t_p)} = \frac{t_p}{2(t_p - t_a)} \overset{def}{=} i_s^2$$

switch over, i.e.

$$i_s^2 - 1/2 = \frac{t_p}{2(t_p - t_a)} - 1/2 = \frac{t_a}{2(t_p - t_a)} \tag{3}$$

are the number of show type switchers. Then $I_i = t_p$ for $1/2 < i \leq i_s^2$ and $I_i = 1 - t_a$ for $i_s^2 < i \leq 1$.

We can now distinguish four possible outcomes for the introduction of Public Service TV (see Figure 1).

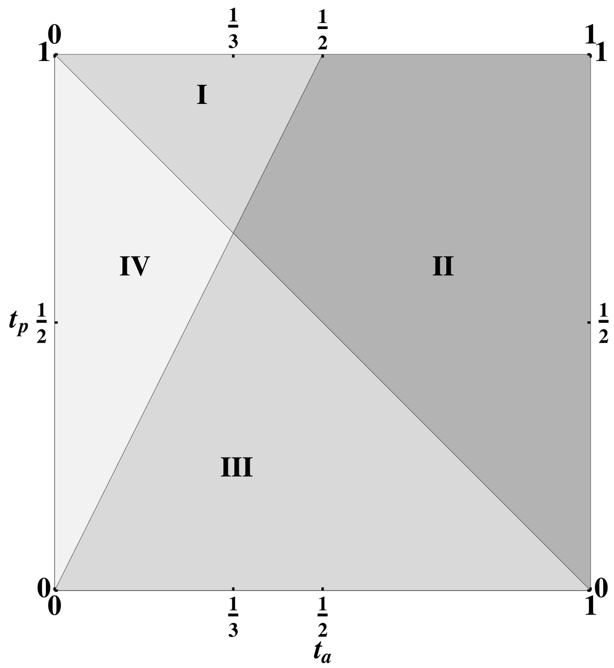

Figure 1: Regions I to IV

First, all former information consumers and, at the same time, some former show channel consumers switch to the Public Service TV channel if $t_a \leq 1/3$ and $t_p \geq 1 - t_a$ or $t_a \geq 1/3$ and $t_p \geq 2t_a$ (Region I). In this case

$$Y = 1/2 t_p^\alpha + \frac{t_a}{2(t_p - t_a)} t_p^\alpha = \frac{t_p^{1+\alpha}}{2(t_p - t_a)}. \tag{4}$$

Therefore, a Public Service TV channel broadcasting a fraction t_p of information changes Y in Region I by

$$\Delta Y_1 = 1/2 \left(\frac{t_p^{1+\alpha}}{t_p - t_a} - (1 - t_a)^\alpha \right). \tag{5}$$

Second, all consumers switch to the Public Service TV channel if $t_a \geq 1/3$ and $1 - t_a \leq t_p \leq 2t_a$ (Region II). In this case

$$Y = t_p^\alpha. \tag{6}$$

Therefore

$$\Delta Y_2 = t_p^\alpha - 1/2(1-t_a)^\alpha. \tag{7}$$

Third, some former information channel consumers and, at the same time, all former show channel consumers switch to the Public Service TV channel if $t_a \leq 1/3$ and $t_p \leq 2t_a$ or $t_a \geq 1/3$ and $t_p \leq 1 - t_a$ (Region III). In this case

$$Y = \frac{1-t_a-t_p}{2(1-t_p)}(1-t_a)^\alpha + \frac{t_a}{2(1-t_p)}t_p^\alpha + 1/2 t_p^\alpha. \tag{8}$$

Therefore

$$\Delta Y_3 = \frac{(1-t_p)t_p^\alpha + t_a(t_p^\alpha - (1-t_a)^\alpha)}{2(1-t_p)}. \tag{9}$$

And fourth, some former information channel consumers and some former show channel consumers switch if $t_a \leq 1/3$ and $2t_a \leq t_p \leq 1 - t_a$ (Region IV). In this case

$$Y = \frac{1-t_a-t_p}{2(1-t_p)}(1-t_a)^\alpha + \frac{t_a}{2(1-t_p)}t_p^\alpha + \frac{t_a}{2(t_p-t_a)}t_p^\alpha. \tag{10}$$

Therefore

$$\Delta Y_4 = 1/2\left[t_p^\alpha + t_a\left(\frac{(1-t_a)^\alpha}{t_p-1} + t_p^\alpha\left(\frac{1}{1-t_p} + \frac{1}{t_p-t_a}\right)\right)\right]. \tag{11}$$

Simple calculation shows that ΔY is continuous, i.e. $\Delta Y_i = \Delta Y_j$ if the combination (t_a, t_p) is an element of Region i as well as of Region j. The Public Service TV channel chooses $(t_p, 1-t_p)$ to maximize the change of Y. Let t_p^* be the value that maximizes ΔY.

Proposition 1 *For all* $0 < t_a \leq 1/2$ *there exists an* $0 < \alpha^* < 1$ *such that*

$$t_p^* = \begin{cases} 1 & \textit{if } \alpha > \alpha^* , \\ 2t_a & \textit{if } \alpha \leq \alpha^*. \end{cases}$$

For $t_a > 1/2$ *the optimal value is* $t_p^* = 1$.

Proof: See Appendix.

For $t_a > 1/2$ the intuition for the optimal value $t_p^* = 1$ is as follows. There are only two alternatives of program design: The Public Service TV channel broadcasts an amount of information t_p with $t_p > 1 - t_a$ (Region II) or an amount of information t_p with $t_p < 1 - t_a$ (Region III). In Region II all consumers who prefer information switch to Public Service TV because it broadcasts more information than the private information channel. Simultaneously, all show-type consumers switch to Public Sercvice TV because even show-type consumers prefer news over commercials that are heavily broadcasted by the private show channel ($t_a > 1/2$). In Region III, as in Region II, all show-type consumers switch because the fraction of broadcasted shows is larger than in Region II. But in contrast to Region II only some information-type consumers switch to Public Service TV because it broadcasts less information than the private information channel. With regard to the number of new Public Service TV channel viewers, Region III is therefore dominated by Region II. In addition, for both types of consumers the amount of information consumption per viewer is larger in Region II. To summarize, the number of viewers of Public Service TV and the consumption of information per viewer is larger in Region II, so that Region II dominates Region III in both ways. Furthermore, in Region II all consumers switch to Public Service TV independent of the informational share of the program. To maximize the voters' consumption of information, the Public Service TV channel therefore sets $t_p^* = 1$ and Public Service TV is an information-only program.

For $1/3 < t_a \leq 1/2$ there are three alternatives. Region III is still dominated by Region II which therefore has to be compared to Region I, where all information-type consumers but only some show-type consumers switch. In Region II the Public Service TV channel is able to set the maximal value $t_p = 2t_a$ without losing a viewer. For Region I the optimal t_p is not that obvious. For the information-type consumers the same argument as in $t_a > 1/2$ applies: All consumers switch and watch more information compared to the amount they would have done watching the private channel. The highest $t_p = 1$ is the optimum when considering the information types only. However, in Region I the Public Service TV channel only attracts a part of the show-type consumers. Furthermore, the number of newly attracted viewers decreases with an increase in t_p. On the other hand, switchers from the group of show consumers who keep watching the Public Service TV channel consume more information if t_p was increased. This positive effect, however, cannot compensate the decrease of show consumers. Therefore, the lowest $t_p = 2t_a$ is the optimum regarding the show consumers only. The question remains, which group generates a higher change of the outcome Y. The answer depends on the value of α. A high value of α means that the productivity of getting additional information is diminishing at a low rate. For example, with $\alpha = 1$ an additional minute of information generates the same additional Y in case this minute is watched by a viewer who has already seen a lot of news as well as in case this minute is the first minute of information a consumer watches. With a high α it is therefore not that important which consumers switch and it might be optimal to set a high t_p although some show consumers refrain from switching. In this case it would be optimal to set $t_p^* = 1$ for a wide range of t_a. For a small α it is important to attract the show consumers because the consumption of additional information is more efficient for this group. Therefore, in the case of a small α

it is optimal to set a smaller $t_p = 2t_a$ for a wide range of t_a. To summarize, for $1/3 < t_a \leq 1/2$ either $t_p = 1$ or $t_p = 2t_a$ is optimal, depending on the value of α.

For $0 < t_a \leq 1/3$ there are again three alternatives. Region I, III, and IV where some show-type consumers and some information type of consumers switch.

In Region III it is optimal to set $t_p^* = 2t_a$. It is intuitive that this is the optimal value for the group of show consumers because in this region all show consumers switch and $t_p = 2t_a$ is the maximal value within reach. For the group of information consumers the positive effect of an increasing t_p is not that obvious. In this region information-type consumers who switch to the Public Service TV channel watch less information compared to the amount they would have when watching the private channel. Furthermore, increase in information broadcasting attracts additional information-type consumers. This effect suggests a low optimal t_p in Region III. Let us consider a certain increase in t_p that causes one information-type consumer to switch to the Public Service TV channel and, therefore, lowering his information consumption. However, increase in t_p reduces the loss of information of all other information-type consumers who have switched to the Public Service TV channel. This positive effect may compensate for the loss of information the additional switcher implies. And in fact, the negative effect generated by one additional switcher is always compensated by the reduction of loss of the other switchers. Because for both groups the increase of information broadcasting on the Public Service TV channel generates positive effects, it is optimal to set the maximal $t_p^* = 2t_a$ in Region III.

In Region IV the argument for the information-type consumers remains the same: regarding these consumers the optimal value is the largest within reach, $t_p^* = 1 - t_a$. But, in contrast to Region III, in Region IV only some show-type consumers switch to the Public Service TV channel. As already discussed, in this case an increase in t_p effects the show consumers negatively. For every fraction of a time unit the private channel broadcasts commercials t_a, there exists a t_p where the positive effect of an increase of t_p generated by the group of information consumers exactly compensates the negative effect induced by the group of show consumers. If t_p was further increased, the positive effect for the group of information consumers would overcompensate the negative effect for the group of show consumers. If t_p was decreased, the positive effect for the group of show consumers would overcompensate the negative effect for the group of information consumers. As the appendix shows, the latter case is optimal. It is optimal to choose the minimal $t_p = 2t_a$ reachable in Region IV.

In Region I the optimal t_p depends on the value of α and is either $t_p = 1$ or $t_p = 1 - t_a$. The intuition is the same as discussed for $1/3 < t_a \leq 1/2$. But in contrast to that case, for $0 < t_a \leq 1/3$ the minimal t_p in Region I is $t_p = 1 - t_a$. However, this is also the maximal t_p in Region IV. It has already been argued that

$t_p = 1 - t_a$ is dominated by $t_p = 2t_a$ in Region IV. It follows that for $0 < t_a \leq 1/3$ the optimal t_p is $t_p = 1$ for a high α and $t_p = 2t_a$ for a small α. We are now able to summarize that for $0 < t_a \leq 1$ the optimal t_p is either $t_p = 1$ or $t_p = 2t_a$.

If private channels predominantly broadcast commercials, i.e. $t_a > 1/2$, then it is optimal to set $t_p^* = 1$. This induces all former information channel consumers to switch to the Public Service TV channel. Because the Public Service TV channel broadcasts information only, former information channel consumers now watch more information and Y increases. Former show channel consumers also switch. In contrast to watching commercials, watching information generates a positive utility. For switching show consumers this utility is greater than the utility generated by the sparse show program on the private channel. The former show channel consumers also increase Y. Even if some show consumers refrain from switching (for $t_a < 1/2$), it can be optimal to set $t_p = 1$. But there exists a critical t_a for which it is optimal to set $t_p = 2t_a$. If the fraction of commercials t_a is small, i.e. $t_a < 1/2$, the utility of show-type consumers from the consumption of private channels is comparatively large and the information only Public Service TV channel may not compensate for the utility loss caused by missing shows. Thus, some show consumers refrain from switching. However, depending on the value of α, it can still be optimal to set $t_p = 1$ since this is the optimum considering the information-type consumers. To summarize, for each α there exists a critical t_a^* so that it is optimal to set $t_p = 1$ for $t_a > t_a^*$ and $t_p = 2t_a$ for $t_a \leq t_a^*$.

From a welfare point of view, we have to weigh the costs of the introduction of Public Service TV against its benefits. The costs are not only the production costs for the Public Service TV channel but also the lost rents for the private TV channels and advertisers that lose consumers. These costs have to be compensated by the benefits from introducing Public Service TV and the additional rents for consumers. Because of

$$\Delta Y_{1|t_p=1} = \frac{1}{2}\left(\frac{1}{t_p - t_a} - (1 - t_a)^\alpha\right) = \frac{1}{2}\left(\frac{1 - (1 - t_a)^{\alpha+1}}{1 - t_a}\right) > 0 \tag{12}$$

and

$$\Delta Y_{2|t_p=1} = 1^\alpha - \frac{1}{2}(1 - t_a)^\alpha > 0, \tag{13}$$

and the fact that the maximum value of ΔY at t_p^* is at least as large as the value of ΔY at $t_p = 1$, the output for democracy ΔY is positive for all t_p^*. The additional rents for consumers are positive because consumers switch or do not switch to Public Service TV by choice. If the positive effects are larger than the negative effects, the introduction of Public Service TV generates a welfare improvement.

In case private TV channels predominantly broadcast commercials, that is $t_a > 1/2$, this welfare improvement is generated by a Public Service TV channel broadcasting information only. The reason for the welfare improvement is that information-type consumers watch information not shortened by commercials. Show-type consumers still stay with their preferred private TV channel that only broadcasts entertainment and commercials and therefore refrain from watching any information.

However, in most countries the share of commercials is regulated to less than 1/2, that is $0 < t_a < 1/2$ (Anderson, 2007). In this case, the magnitude of α determines whether it is worthwhile from a welfare perspective to broadcast shows enclosing information. Broadcasting shows instead of information attracts additional showtype consumers and thereby increases aggregate information consumption in this group of consumers. But it simultaneously decreases aggregate information consumption within the group of information-type consumers. Since α determines the rate by which the marginal productivity of information consumption diminishes, it constitutes the decisive parameter to balance both effects. The lower α the larger is the positive effect of additional aggregate information consumption within the group of show consumers compared to the negative effect of lower aggregate information consumption within the group of information consumers. For a given t_a, α^* is the value where the positive effect dominates and where it gets worthwhile to broadcast entertaining shows, i.e. $t_s^* = 1 - 2\ t_a$, as well as information, $t_p^* = 2\ t_a$. The welfare improvement in this case is partly generated by subsidizing the show consumption of the show-type consumers who are willing to watch some information in return. Decreasing marginal returns of the factor information in the production process of democracy make it worthwhile to broadcast shows in exchange for the attention of show consumers whose information consumption is marginally more productive than that of the information-type consumers.

3 Conclusion

By showing that rational individuals may use a Public Service TV station as welfare-improving institution to solve the paradox of rationally being uninformed, we disprove the common argument that Public Service TV should not broadcast a program that is also provided by private channels. Even though in many markets most types of programs are covered, Public Service TV stations are not redundant.

Following our results, the optimal Public Service TV broadcasts the soccer world championships final and uses the half-time interval to broadcast serious news. The Public Service TV broadcasts special shows targeted to groups usually not interested in policy concerns to increase their voting attendance (Prat and Strömberg, 2005) by broadcasting serious news in between the shows.

It is not necessary to have a Public Service Broadcaster to place serious news into TV shows. Another institutional form could be a Public TV board that buys informational broadcasts and serious news from private producers and pays private TV channels a fee for broadcasting this program instead of commercials. Which type of institution is optimal depends on the cost efficiency of these different institutions and the fixed costs of market entry, which are already sunk for existing Public Service Broadcasters like BBC or ARD and ZDF.

In any case, Public Service TV has to be independent because politicians do not aim to solve the voters paradox of rational ignorance but aim to seek re-election (Prat and Strömberg, 2005) or, as Djankov et al. (2003) concludes his empirical findings of a large sample of countries, to enrich or empower themselves. Voters therefore prefer an independent Public Service TV with the aim of improving the information of voters.

If economists want to contribute to the discussion of how many channels Public Service TV should offer, how much Public Service TV should spend on sport licenses, and whether they also should offer their content in the world wide web, they have to compare costs and benefits which are the saved costs of bad democratic decisions. Because empirical literature in economics about the effects of information on democratic decisions is scarce, politicians currently rely their decisions primarily on other social sciences.

Appendix: Proof of Proposition 1

To proof Proposition 1 we use the following Lemmas

Lemma 1 *In Region I*

$$\frac{\partial \Delta Y_1}{\partial t_p} \gtreqless 0 \textit{ iff } t_p \gtreqless \frac{(1+\alpha)t_a}{\alpha} \tag{14}$$

Proof: Because

$$\frac{\partial \Delta Y_1}{\partial t_p} = -\frac{t_p^\alpha(t_a + \alpha t_a - \alpha t_p)}{2(t_a - t_p)^2}$$

the equation holds:

$$\frac{\partial \Delta Y_1}{\partial t_p} = 0 \text{ iff } t_p = \frac{(1+\alpha)t_a}{\alpha}. \tag{15}$$

The second partial derivative

$$\begin{aligned} \frac{\partial^2 \Delta Y_1}{\partial t_p \partial t_a} &= -\frac{(1+\alpha)t_p^\alpha}{2(t_a - t_p)^2} + \frac{t_p^\alpha(t_a + \alpha t_a - \alpha t_p)}{(t_a - t_p)^3} \\ &= \frac{-(1+\alpha)(t_a - t_p)t_p^\alpha + 2(t_p^\alpha(t_a + \alpha t_a - \alpha t_p))}{2(t_a - t_p)^3} \end{aligned} \tag{16}$$

is negative because

$-(1+\alpha)(t_a - t_p) + 2(t_a + \alpha t_a - \alpha t_p) = t_a(-(1+\alpha) + 2(1+\alpha)) + t_p((1+\alpha) - 2\alpha) > 0.$

The monotonicity of $t_p = (1-\alpha)t_a/\alpha$ proofs the Lemma. □

Lemma 2 *In Region II the optimal Public Service TV channel is of type*

$$t_p^* = \begin{cases} 2t_a & \textit{if } t_a < 1/2, \\ 1 & \textit{if } t_a > 1/2 \end{cases}$$

Proof:

$$\frac{\partial \Delta Y_2}{\partial t_p} = \alpha t_p^{\alpha-1} > 0.$$

Lemma 3 *For all $t_a > 1/3$ and for all $t_{p3} < 1 - t_a$ there exists a $1 - t_a < t_{p2} < 2t_a$ such that $\Delta Y_2(t_a, t_{p2}) > \Delta Y_3(t_a, t_{p3})$.*

Proof:

$$\Delta Y_2(t_a, t_{p2}) - \Delta Y_3(t_a, t_{p3}) = \frac{t_a(-(1-ta)^\alpha + t_{p3}^\alpha) + (1-t_{p3})((1-t_a)^\alpha - 2t_{p2}^\alpha + t_{p3}^\alpha))}{2(t_{p3} - 1)} > 0$$

because

1. $t_a(-(1-ta)^\alpha + t_{p3}^\alpha) < 0$
2. $((1-t_a)^\alpha - t_{p2}^\alpha - t_{p2}^\alpha + t_{p3}^\alpha)) < 0$
3. $2(t_{p3} - 1) < 0$

$\square$

Lemma 4 *In Region III*

$$\frac{\partial \Delta Y_3}{\partial t_p} > 0. \tag{17}$$

Proof:

$$\frac{\partial \Delta Y_3}{\partial t_p} = \frac{(\alpha(-1+t_p)^2 t_p^\alpha + t_a(-(1-t_a)^\alpha t_p + \alpha t_p^\alpha - (-1+\alpha)t_p^{1+\alpha}))}{(2(-1+t_p)^2 t_p)}$$

which is positive iff

$$\Gamma = \alpha(-1+t_p)^2 t_p^\alpha - t_a(1-t_a)^\alpha t_p + \alpha t_a t_p^\alpha + (1-\alpha)t_a t_p^{1+\alpha} > 0$$

Using the equation

$$\alpha t_a t_p^\alpha + (1-\alpha)t_a t_p^{1+\alpha} = t_a t_p^\alpha + (1-\alpha)t_a t_p$$

we calculate

$$\Gamma = \alpha(-1+t_p)^2 t_p^\alpha - t_a(1-t_a)^\alpha t_p + t_a t_p^\alpha + (1-\alpha)t_a t_p.$$

Because $(1-t_a)^\alpha < 1$ and $t_p < t_p^\alpha$ it follows

$$t_a(1-t_a)^\alpha t_p < t_a t_p^\alpha.$$

and therefore,

$$\Gamma > \alpha(-1+t_p)^2 t_p^\alpha - t_a t_p^\alpha + t_a t_p^\alpha + (1-\alpha)t_a t_p > 0.$$

$\square$

Lemma 5 *In Region IV, i.e. for all* $1 \le t_a \le 1/3$ *and all* $2t_a < t_p \le 1 - t_a$,

$$\Delta Y_4(t_a, 2t_a) > \Delta Y_4(t_a, t_p)$$

Proof:

$$\Delta Y_4(t_a, 2t_a) = \frac{(1-t_a)^\alpha t_a + 2^\alpha(-1+t_a)t_a^\alpha}{-2+4t_a} \tag{18}$$

Therefore

$$\begin{aligned}
\Delta Y_4(t_a, 2t_a) - &\Delta Y_4(t_a, t_p) = \\
&\frac{(1-t_a)^\alpha t_a + 2^\alpha(-1+t_a)t_a^\alpha}{-2+4t_a} - \frac{t_a\left((1-t_a)^\alpha + \frac{(-1+t_a)t_p^\alpha}{-t_a+t_p}\right)}{2(-1+t_p)} \\
&= \frac{2(-1+t_p)\left((1-t_a)^\alpha t_a + 2^\alpha(-1+t_a)t_a^\alpha\right)}{(-2+4t_a)2(-1+t_p)} \\
&- \frac{(-2+4t_a)t_a\left((1-t_a)^\alpha + \frac{(-1+t_a)t_p^\alpha}{-t_a+t_p}\right)}{(-2+4t_a)2(-1+t_p)}
\end{aligned} \tag{19}$$

which is positive if the sum of the enumerators is positive, i.e.

$$\begin{aligned}
\Psi =& 2\left((1-t_a)^\alpha t_a + 2^\alpha(-1+t_a)t_a^\alpha\right)(-1+t_p) \\
&- t_a(-2+4t_a)\left((1-t_a)^\alpha + \frac{(-1+t_a)t_p^\alpha}{-t_a+t_p}\right) > 0
\end{aligned} \tag{20}$$

Because $t_p < 1 - t_a$, $-1 + t_a + t_p < 1$ holds and therefore

$$\lim_{\alpha\to 1} \Psi = \frac{2(-1+t_a)t_a(2t_a-t_p)(-1+t_a+t_p)}{t_a-t_p} > 0. \tag{21}$$

Thus, it is sufficient to show that $\partial\Psi/\partial\alpha < 0$ for all $0 \leq \alpha < 1$ to proof the lemma.

$$\begin{aligned}
\frac{\partial \Psi}{\partial \alpha} =& -2(1-t_a)^\alpha t_a(2t_a-t_p)\mathrm{Log}[1-t_a] \\
&+ 2(-1+t_a)\left(2^\alpha t_a^\alpha(-1+t_p)\mathrm{Log}[2t_a] + \frac{t_a(-1+2t_a)t_p^\alpha \mathrm{Log}[t_p]}{t_a-t_p}\right)
\end{aligned} \tag{22}$$

Because

1. $-2(1-t_a)^\alpha t_a(2t_a-t_p)\mathrm{Log}[1-t_a] < 0$
2. $2(-1+t_a) < 0$

it is sufficient to show that

$$2^\alpha t_a^\alpha(-1+t_p)\mathrm{Log}[2t_a] + \frac{t_a(-1+2t_a)t_p^\alpha \mathrm{Log}[t_p]}{t_a-t_p} > 0$$

$$\iff (t_a-t_p)(2t_a)^\alpha(-1+t_p)\mathrm{Log}[2t_a] < -t_a(-1+2t_a)t_p^\alpha \mathrm{Log}[t_p]$$

$$\iff (t_p - t_a)(2t_a)^\alpha(1-t_p)\mathrm{Log}[2t_a] < t_a(1-2t_a)t_p^\alpha\mathrm{Log}[t_p]$$

$$\iff (t_p - t_a)(2t_a)^\alpha(1-t_p)\mathrm{Log}[2t_a] < t_a(1-2t_a)t_p^\alpha\mathrm{Log}[t_p]$$

$$\iff \frac{t_p - t_a}{t_a}\frac{(2t_a)^\alpha\mathrm{Log}[2t_a]}{(1-2t_a)} < \frac{t_p^\alpha\mathrm{Log}[t_p]}{(1-t_p)}.$$

Let

$$\Phi(x) = \frac{\mathrm{Log}[x]}{(1-x)}$$

then

$$\frac{\partial\Phi}{\partial x} = \frac{(1-x+x\mathrm{Log}[x])}{x(x-1)^2} > 0$$

and therefore

$$\frac{\mathrm{Log}[2t_a]}{(1-2t_a)} < \frac{\mathrm{Log}[t_p]}{(1-t_p)} < 1.$$

Then it is sufficient to show that

$$(t_p - t_a)(2t_a)^\alpha > t_p^\alpha t_a.$$

For $t_p > 2t_a$

$$\frac{2t_a}{t_p} > \frac{t_a}{t_p - t_a}$$

and

$$\frac{2t_a}{t_p} < \left(\frac{2t_a}{t_p}\right)^\alpha.$$

It follows that

$$\left(\frac{2t_a}{t_p}\right)^\alpha > \frac{t_a}{t_p - t_a}$$

or equivalently

$$(t_p - t_a)(2t_a)^\alpha > t_p^\alpha t_a.$$

□

Lemma 6

$$\Delta Y_1(t_a, 1-t_a) < \Delta Y_3(t_a, 2t_a) \tag{23}$$

Proof:

$$\Delta Y_1(t_a, 1-t_a) = -\frac{(1-t_a)^\alpha t_a}{-2(1-t_a)+2t_a}$$

and

$$\Delta Y_3(t_a, 2t_a) = \frac{(1-t_a)^\alpha t_a + 2^\alpha(-1+t_a){t_a}^\alpha}{-2+4t_a}.$$

Because $t_a < 1/3$,

$$\Delta Y_3(t_a, 2t_a) - \Delta Y_1(t_a, 1-t_a) = \frac{2^{-1+\alpha}(-1+t_a){t_a}^\alpha}{-1+2t_a} > 0.$$

□

Now we can proof Proposition 1:

Let $0 < t_a < 1/3$. According to Lemma 1 either $t_p = 1$ or $t_p = 1-t_a$ is optimal in Region I. According to Lemma 6 $t_p = 1-t_a$ is dominated by $t_p = 2t_a$. Lemma 5 shows that $t_p = 2t_a$ is optimal in Region IV and, as Lemma 4 shows, in Region III also. Therefore, either $t_p = 1$ or $t_p = 2t_a$ is optimal for $0 < t_a < 1/3$. Let

$$\Psi = \Delta Y_3(t_a, 2t_a) - \Delta Y_1(t_a, 1),$$

then

$$\frac{\partial \Psi}{\partial \alpha} = \frac{(1-t_a)^\alpha(-1+3t_a)\log[1-t_a] + 2^\alpha(-1+t_a)t_a^\alpha \log[2t_a]}{-2+4t_a} < 0,$$

$$\lim_{\alpha\to 0}\Psi = \frac{1-2t_a}{2-2t_a} > 0 \quad \text{and} \quad \lim_{\alpha\to 1}\Psi = -\frac{t_a(1-3t_a+t_a^2)}{2-6t_a+4t_a^2} < 0.$$

which proofs the proposition for $0 < t_a < 1/3$.

Let $1/3 < t_a < 1/2$. According to Lemma 1 either $t_p = 1$ or $t_p = 2t_a$ is optimal in Region I. According to Lemma 3 $t_p < 1-t_a$ is dominated by a t_p in Region II. According to Lemma 2 $t_p = 2t_a$ is optimal in Region II. Therefore, for $1/3 < t_a < 1/2$ either $t_p = 1$ or $t_p = 2t_a$ is optimal. Let

$$\Psi = \Delta Y_2(t_a, 2t_a) - \Delta Y_1(t_a, 1).$$

Then

$$\frac{\partial \Psi}{\partial \alpha} = 2^\alpha t_a^\alpha \log[2] + 2^\alpha t_a^\alpha \log[t_a] < 0,$$

$$\lim_{\alpha\to 0}\Psi = 1 + \frac{1}{2(t_a-1)} > 0 \quad \text{and} \quad \lim_{\alpha\to 1}\Psi = -\frac{(1-2t_a)^2}{2(t_a-1)} < 0,$$

which proofs the proposition for $1/3 < t_a < 1/2$.

Let $1/2 < t_a$. According to Lemma 3, $t_p < 1 - t_a$ is dominated by a t_p in Region II. As Lemma 2 states, $t_p = 1$ is optimal in Region II, which proofs the proposition for $1/2 < t_a$.

$\square$

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